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Metathesis in Maltese: Implication for the Strong Morphemic Plane Hypothesis

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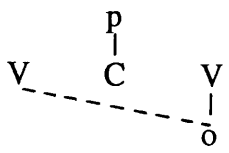
0. Introduction

Processes of vowel movement across an intervening consonant serve as a good testing-ground for nonlinear models of feature organization. Within the well-motivated view of assimilation as spreading, the features of consonants and vowels must be sufficiently disjunctive to allow for the spreading of vowel features across those of a consonant without violating the Line-Crossing Prohibition on phonological representations (Goldsmith 1976).

McCarthy (1989b) convincingly shows the inadequacy of current models of feature geometry to account for certain cases of consonant/vowel metathesis, a process which he treats as spreading a vowel's features across those of a consonant. He attributes metathesis to planar V/C segregation and further suggests that metathesis implies planar segregation. By invoking planar segregation, the movement of a vowel across a consonant can be characterized as in (1). With the melodies of consonants and vowels arrayed on separate planes, vowel features can spread freely across a consonant without crossing association lines.

(1) Vowel spreading: planar segregation (based on e.g. McCarthy 1989b)

e.g.



As stated in (2), the Strong Morphemic Plane Hypothesis (SMPH) limits planar V/C segregation to cases in which consonants and vowels constitute separate morphemes. By doing so, the SMPH provides an effective diagnostic for determining when planar segregation can be invoked and strongly constrains its power in phonological theory.

(2) Strong Morphemic Plane Hypothesis: Segmental matrices belong to distinct planes if and only if they belong to distinct morphemes. (Steriade 1986:129, see also e.g. Archangeli & Pulleyblank 1986, Cole 1987)

However, in McCarthy (1989b) it is argued that planar V/C segregation is required to account for C/V metathesis even in languages in which consonants and vowels do not constitute separate morphemes. Metathesis thus serves as partial evidence for falsifying the strong version of this principle.

In this paper I present independence evidence that not all cases of C/V metathesis can be attributed to planar segregation. The evidence comes from Maltese Arabic. Like other Arabic dialects, Maltese's verbal morphology is templatic, comprised of a prosodic template, a consonantal root and a vocalic melody, with each serving a specific semantic function in varying degrees. This then would seem to be a case in which we would expect planar segregation to be applicable. I argue, however, that this account is not available. Alternatively, with an enriched model of feature geometry, there is an alternative means of representing vowel movement which does not require complete planar V/C segregation. With the availability of this alternative, I would suggest that we are able to account for cases of C/V metathesis which would otherwise constitute exceptions to the Strong Morphemic Plane Hypothesis.

The focus of this paper is on the perfective and imperfective verbs of Standard Maltese Arabic. All verbs to be discussed belong to the first binyan of the strong triliteral verb. The data are drawn from a wide range of sources which include Aquilina (1959), Berrondonner et al (1983), Borg (1973), Brame (1972, 1973), Bugeja (1984), Busuttil (1981), Butcher (1938), Puech (1978, 1979) and Sutcliffe (1939). These data are consistent with the variety of Maltese spoken by my consultants. The organization of this paper is as follows. In the first section, I lay out the typical formation of the imperfective plural and discuss facts relevant to the subsequent analysis. Following this, I discuss a group of imperfective plural verbs which evidence metathesis. After motivating the claim that metathesis is in fact involved, I show that vowel movement across an intervening consonant in metathesis cannot be attributed to planar V/C segregation. Finally, by drawing on the enriched model of feature organization proposed in Clements (in press), an alternative account is given. For further discussion and motivation of the points concerning Maltese discussed in this paper, I refer the reader to Hume (in press, 1990a,b).

1. The Plural Imperfective (First Binyan)

The verbs in (3) represent the typical formation of the plural imperfective of the first binyan triliteral verb. In each of these verbs, the stem is comprised of three radical consonants, -CCC-, to which the invariable suffix [-u] is added. The imperfective, both singular and plural, is characterized by a prefix of the form CV-. In the absence of assimilation processes (see e.g. guttural assimilation), the imperfective prefix vowel is identical to the underlying quality of the following stem vowel. The prefix consonant varies according to person: [n-] = 1st pers.; [t-] = 2nd pers., 3rd pers. fem.; [y-] = 3rd pers. masc. For reasons of simplicity, the imperfective verbs will appear in the third person.

(3)

	Imperfective		*Perfective*	*Stem vowel*	*Gloss*
	3rd p.pl.	*3rd p.m.sg.*	*3rd p.m.sg.*		
a.	ya+ħbt+u	ya+ħbat	ħabat	/a/	'to strike'
b.	yo+ktr+u	yo+ktor	kotor	/o/	'to abound'
c.	yi+bdl+u	yi+bdel	bidel	/i/	'to change'
d.	yi+lħ?+u	yi+lħa?	laħa?	/i/	'to reach'

Following Puech (1979), I derive the imperfective stem from the canonical structure CVCVC which, as shown in (3), characterizes the template of the perfective, third person masculine singular. In deriving the singular imperfective, the first stem vowel deletes resulting in the -CCVC stem shown above. For the plural imperfective, both stem vowels delete with the resultant stem having the form -CCC-. This vowel deletion is accounted for by the rule of Syncope given in (4) (based on Brame 1972).

(4) Syncope: $\check{V} \rightarrow \emptyset \; / \_\_ CV$
An unstressed vowel in a non-final open syllable deletes.

Informally, this states that an unstressed vowel in an open syllable deletes when followed by a consonant and vowel. Stress assignment in Maltese Arabic is similar to that of most Arabic dialects. For the purposes of this paper, it will suffice to say that stress usually falls on a final superheavy syllable, e.g. CV:C, CVCC. If there isn't one, it falls on the penultimate if heavy, e.g. CV:, CVC, otherwise the antepenult is stressed (see Brame 1972, 1973 for a detailed discussion). The effects of syncope are evidenced more generally in Maltese. For example, all forms of the perfective can equally be derived from the canonical structure CVCVC, as proposed for the imperfective (Hume 1990b).

Contrary to earlier analyses (see e.g. Brame 1972, Puech 1979), I claim that when syncope applies only the vowel slot of the prosodic template is deleted, the vocalic melody remains floating. By universal association conventions (Goldsmith 1976), the floating melody links up to an empty vowel slot if one is available. For ease of exposition, I refer to this association as vocalic mapping and formulate it as in (5).

(5) Vocalic Mapping:

V | [ ]'	A floating vocalic melody maps onto a V-slot (where [ ]' indicates an unassociated vocalic melody).

Syncope and vocalic mapping allow for a straightforward account of the realization of the imperfective prefix vowel. Furthermore, as will be discussed below, these two operations are instrumental in accounting for metathesis in certain plural imperfectives. The derivation of the plural imperfective is given in (6). Note that Syncope is a cyclic rule (Hume 1990b) and although not explicit in this and subsequent derivations, I assume that stress is reassigned at the beginning of each cycle.

(6)

e.g.	[[yV[ħabat]]u]	
1st cycle	ħábat	
Syncope	n/a	
2nd cycle	yVˊħabat	
Syncope	yVħ bat [a]'	
Vocalic Mapping	yVħ bat [a]'	
3rd cycle	yáħbatu	
Syncope	yaħb tu [a]'	
Vocalic Mapping	n/a	
Output	[yaħbtu]	'they strike'

As shown in (6), the addition of the imperfective prefix triggers deletion of the first stem vowel resulting in the stem -CCVC. The floating melody maps onto the vowel of the prefix which, for independent reasons, I claim enters into the derivation unspecified for features. In the third cycle, the addition of the imperfective suffix [-u] causes the deletion of the second stem vowel giving the plural imperfective stem -CCC-. Since in the typical formation of the plural imperfective there is no empty vowel slot available, the floating melody of the second vowel is not phonetically realized.

2. Vowel Quality

As originally observed by Berrondonner et al (1983), each verb stem is associated with a single vocalic melody in underlying representation. (In (3), the vocalic melody of each verb stem is indicated to the right.) In many verbs, the surface realization of the stem vowel(s) is identical in quality to the underlying vocalic melody. This is the case for [ħabat] 'he struck' and [kotor] 'he increased/abounded' seen in (3), for example. For verbs such as [bidel] 'to change' and [laħaʔ] 'to reach', on the other hand, the surface quality of the stem vowels differs from the underlying vocalic melody. In both of these verbs, I claim that the underlying vocalic melody is /i/.

There are two phonological rules affecting vowels which are of particular relevance to the present discussion. The first, following Brame (1972, 1973) and Puech (1979), accounts for the i~e alternation observed in verb forms. For example, this alternation is evidenced in perfective forms such as bid̲e̲l 'he changed', bd̲i̲l+t 'I changed'. When followed by a single word-final consonant, the second stem vowel surfaces as [e], otherwise it is [i]. (The first stem vowel has deleted as a result of syncope.) We also see this alternation in the 3rd pers. fem. suffix as shown in (7).

(7) 3rd pers. fem. suffix [-it]~[-et] (examples from Brame 1972:26):
[ħatf+i̲t+kom] 'she grabbed you' cf. [ħatf+e̲t] 'she grabbed'
[bezʔ+i̲t+l+ek] 'she spit to you' cf. [bezʔ+e̲t] 'she spit'

The alternations illustrated above are characteristic of the broader observation that short [i] never precedes a single word-final consonant. In cases where we might expect [i], it is [e] that surfaces. Following Puech (1979), I refer to the rule accounting for this alternation as i-lowering given in (8).

(8) i-lowering (Puech 1978, see also Brame 1972)
/i/ -> [e]/ __C#

Informally, this says that /i/ lowers to [e] when followed by a single consonant in word-final position. Positing the underlying form /bidil/ for the verb [bidel] 'he changed' thus accounts for the alternation i~e of the final stem vowel and is consistent with the claim that a given stem is associated with a vocalic melody of a single quality in underlying representation.

The second rule, guttural assimilation (GA), is central to the argument below. As indicated in (3d), for example, the underlying vocalic melody of the verb 'to reach' is /i/. Due to the influence of an adjacent guttural consonant, /i/ surfaces as [a], e.g. /liħiʔ/ → [laħaʔ] 'he reached'. The rule accounting for this change is given in (9) (cf. Brame 1972).

(9) Guttural Assimilation: /i/ -> [a] % __ [ħ, ʔ]
The vowel /i/ is realized as [a] when adjacent to the pharyngeal fricative or the glottal stop.

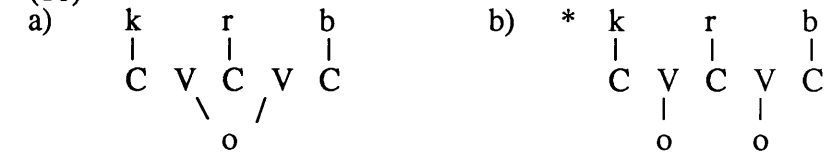
Motivation for guttural assimilation comes in part from facts concerning the distribution of [i] within non-derived verb stems; there are no surface occurrences of [i] next to a guttural consonant, although all other vowels appear in this position (Hume 1990a). Furthermore, positing underlying /i/ allows for a straightforward account of the quality of the prefix vowel in forms such as 'to reach', which as mentioned above, is typically identical to the underlying vocalic melody of the stem, i.e. [yi+lħaʔ] 'he reaches' < /yV+liħiʔ/.

Guttural assimilation is a feature-changing rule which applies bi-directionally. In verbs such as [laħaʔ] 'he reached' < /liħiʔ/, both underlying /i/'s change to [a] with GA applying in both directions. GA also affects a single vowel of the stem, applying, for example, from left to right in [ʔabel] 'he agreed' < /ʔibil/. In this verb, the first vowel undergoes GA and the second lowers to [e] by i-lowering. Guttural assimilation also applies from right to left in non-derived and derived forms, e.g. [ya+ħdem] 'he works' < /yV+ħidim/ (GA, i-lowering). Since GA applies in both derived and non-derived forms, I assume that it is a post-cyclic rule. Moreover, given that it has lexical exceptions, e.g. riħa 'smell', riħi 'relaxation', tberbiʔ 'lavishness' (cf. tberbaʔ 'to lavish'), it is best viewed as a lexical rule.

3. Planar Segregation and Guttural Assimilation

In Maltese Arabic, as in other Arabic dialects, a given verb is comprised of a prosodic template, a consonantism and a vocalism. In McCarthy's important work on the nonlinear organization of consonantal and vocalic melodies in Arabic (e.g. 1979, 1981, 1986a,b), he argues that these melodies are not linearly ordered with respect to each other. Rather, linear ordering is provided by the prosodic template with consonantal and vocalic melodies being arrayed on independent planes. Following McCarthy (1989b), I refer to this organization as planar V/C segregation. This is shown for the Maltese verb [korob], for example, in (10a).

(10)



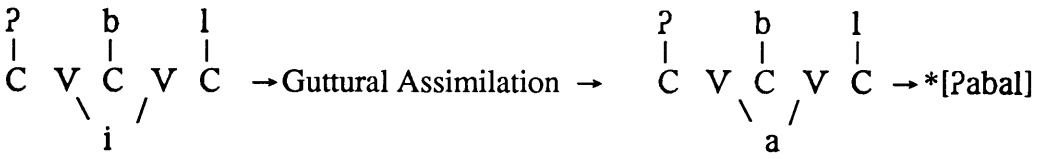
The organization of melodies within a given plane is highly constrained by the Obligatory Contour Principle (OCP) which prohibits adjacent identical melodies. McCarthy (1981) argues that if we assume that the OCP holds of underlying vowel melodies, each melody can be given a single underlying shape, e.g. [o]. Multiple occurrences of [o] are derived by autosegmental spreading. Thus for the verb [korob], the two vowel slots of the template are linked at the root node to the featural content of a single occurrence of [o]. Representing them as in (10b) in which two adjacent [o]'s occur, violates the OCP and is thus ill-formed.

Given that the verbal morphology of Maltese is Semitic, we might expect, following the argumentation of McCarthy, that the melodies of consonants and vowels are on separate planes. Due to the constraints of the OCP, invoking planar V/C segregation for underlying verbs in Maltese would require the multiple-linking of the single vocalic melody to two V-slots as shown in (10a). This follows from

the observation that a given verb stem is associated with a vocalic melody of a single quality in UR. Independent evidence supports the view that the OCP holds of underlying melodies in Maltese. The evidence comes from Morpheme Structure Constraints which, following the argumentation of McCarthy (1986b), Steriade (1987) and Yip (1988), hold of underlying representations. The distribution of root consonants in non-derived verbs of Maltese Arabic prohibits the cooccurrence of adjacent homorganic consonants which agree in their value for the feature [sonorant] (Hume 1990a). The OCP thus holds of underlying consonantal melodies in Maltese. Given this, it is reasonable to assume that the OCP also holds of underlying vocalic melodies. The one-to-many association of the single vocalic melody in (10a) is consistent with this view.

A commonly accepted view regarding multiply-linked structures is that if a given rule affects one part of the structure, the other part will also be affected (e.g. McCarthy 1986a). In view of this, consider the representation of, e.g. [ʔabel] 'he agreed' < /ʔibil/, in (11). This illustrates the consequences of applying guttural assimilation when the melodies of consonants and vowels are segregated. A single feature complex, i.e. [i], is multiply-linked to both vowel slots of the non-derived verb. Recall that Guttural Assimilation, a non-cyclic lexical rule which changes /i/ to [a] when adjacent to [ħ, ʔ], is defined on both the skeletal tier (due to the adjacency requirement) and the melodic tier (the quality of /i/).

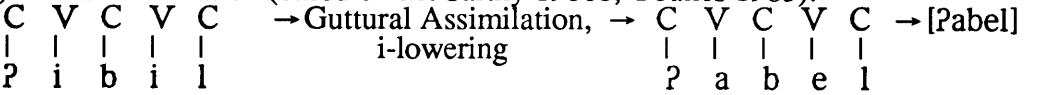
(11) Planar segregation:
e.g. [ʔabel] 'he agreed' < /ʔibil/



Consequently, applying GA as it affects the feature content of /i/ would (incorrectly) result in both vowels being realized as [a]. Note that by invoking the Linking Condition (Hayes 1986), i.e. association lines in structural descriptions are interpreted as exhaustive, Guttural Assimilation would be blocked from applying and both vowels would remain /i/. Accounting for the strictly local affect of guttural assimilation without ad hoc stipulations is thus problematic for an account in which consonantal and vocalic melodies are segregated.

Younes (1983) and McCarthy (e.g. 1986b) claim that at a certain point in the derivation, the planes of consonants and vowels are conflated. In the post-plane conflation stage of the derivation, the verb /ʔibil/ would be represented as in (12). As is evident, the consonantal and vocalic melodies are now linearly ordered and, as a result, the V-slots are no longer multiply-linked to a single feature complex.

(12) Plane conflation (based on McCarthy 1986b, Younes 1983):



When guttural assimilation applies in (12) only the first vowel is affected. The second vowel lowers to [e] by the independently motivated rule of i-lowering. Thus, in order to obtain the strictly local affect of guttural assimilation without ad hoc stipulations, it is crucial that plane conflation has already been invoked by the time GA applies.

4. Summary

Four processes have been shown to be crucial in accounting for the surface realization of vowels in the perfective and imperfective triliteral verbs of the first binyan. Guttural assimilation and i-lowering account for vowel alternations observed in these and other forms. Syncope and vocalic mapping, in conjunction with the two previous rules, provide a straightforward account of the typical realization of the imperfective verb. In addition, I have argued that by the time guttural assimilation applies, the melodies of consonants and vowels cannot be segregated on independent planes. In the following section, I will focus on a group of imperfective plurals which evidence metathesis and then show that due to the interaction of metathesis and guttural assimilation, vowel movement across an intervening consonant must also follow plane conflation.

5. Metathesis

We have seen that the stem of the plural imperfective typically consists of a three consonant cluster. However, as shown in (13), in verbs in which the medial radical consonant is a sonorant, i.e. [m,n,l,r], a vowel occurs to its left. The quality of this vowel is identical to the underlying quality of the vocalic melody, as indicated to the right in (13).

(13)

	Imperfective		*Perfective*	*Stem V*	*Gloss*
	Plural	*Singular*			
a)	yo+korb+u	yo+krob	korob	/o/	'to groan'
b)	yi+ʃorb+u	yi+ʃrob[1]	ʃorob	/o/	'to drink'
c)	ye+ħemz+u	ye+ħmez	ħemez	/e/	'to pin'
c)	ya+ħarb+u	ya+ħrab	ħarab	/a/	'to run away'
d)	ya+ħart+u	ya+ħrat	ħarat	/a/	'to plough'
e)	yi+tilf+u	yi+tlef	tilef	/i/	'to lose'
f)	yi+dinb+u	yi+dneb	dineb	/i/	'to sin'
g)	ya+ħilb+u	ya+ħleb	ħaleb	/i/	'to milk'
h)	ya+ʔilb+u	ya+ʔleb	ʔaleb	/i/	'to overturn'

Following Berrondonner et. al. (1983), Brame (1972) and Puech (1979), the occurrence of the stem vowel in these plural forms can be attributed to metathesis. In other words, the vowel which occurs to the left of the medial sonorant consonant in the plural stem originates to the consonant's right in the singular imperfective. Berrondonner et al (1983) use the following transformational notation to describe this process.

(14) Metathesis: V C R V C V → 1 2 4 3 5 6 (where R = nasal or liquid)
1 2 3 4 5 6

The transformational rule in (14) treats metathesis as a one-step operation in which the sonorant consonant and vowel switch positions. I claim, however, that metathesis in Maltese must be viewed as the product of three elementary operations of non-linear phonology: delink, insert and associate. For a more detailed account of this proposal see Hume (1990c). Before elaborating, however, let me first motivate why the occurrence of the stem vowel in these plural forms is best viewed as the result of metathesis.

6. Motivating Metathesis

In accounting for the occurrence of the plural stem vowel in forms such as (13), the null hypothesis is to assume that this vowel originates in this position and

fails to undergo deletion. In the typical formation it will be recalled that syncope deletes both stem vowels resulting in a three consonant cluster, e.g. [yaħbtu] 'they strike'. Plural imperfectives in which guttural assimilation applies indicate that the null hypothesis cannot be maintained. To illustrate this consider, for example, the plural imperfective [yaħilbu] 'they milk' < /yV+ħilib+u/. The corresponding singular is [yaħleb] 'he milks' < /yV+ħilib/ and the perfective is [ħaleb] 'he milked' < /ħilib/. Assuming that the plural stem vowel originates in that same position and does not delete fails since the first stem vowel in verbs such as [yaħilbu] would be a target for guttural assimilation as shown in (15). Recall that GA applies bidirectionally, and crucially for the present case, it applies from left to right, e.g. [ħaleb] < /ħilib/.

(15)

	yiħilbu
Guttural Assimilation	yaħalbu
Output	* [yaħalbu]

As input to (15), I assume that the prefix vowel has copied the underlying vocalic melody of the stem and that the second stem vowel has been deleted. In addition, the first stem vowel has failed to undergo deletion. With this being the case, the prefix vowel as well as the stem vowel are targets for Guttural Assimilation and we would expect both vowels to surface (incorrectly) as [a]. In order to obtain the correct result, the vowel which surfaces in the plural stem cannot be present in this position when guttural assimilation occurs.

As an alternative to metathesis it might be posited that the presence of the plural stem vowel is the result of epenthesis and receives its quality by default. For verbs such as [yaħilbu] this is an attractive possibility since the epenthetic vowel in Maltese is generally [i]. For example, it has been observed that the vowel [i] occurs before a sonorant consonant, i.e. [m, n, l, r], either when it occurs word-internally between two consonants or word-initially as the first member of a consonant cluster as shown in (16) (e.g. Sutcliffe 1936). In this last case, when the preceding word ends in a vowel, the vowel [i] does not appear. Based on these and other facts, I claim that the default vowel in Maltese is [i].

(16)

a. mess 'he touched', mess+l+kom → [messilkom] 'he touched your...'
(Berrendonner et. al. 1983: 227)

b. irbiit 'act of tying' cf. ʔtiil 'act of killing'
infiiʔ 'act of paying' tliib 'act of praying'
(Brame 1972:34-35)

However, attributing the quality of the epenthetic vowel in plural imperfectives to default assignment fails since we would expect the stem vowel in the plural forms such as (17) to be [i] as well.

(17)

yo+korb+u 'they groan'	yo+krob 'he groans'
yi+solħ+u 'they skin'	yi+sloħ 'he skins'
ye+ħemzu 'they pin'	ye+ħmez 'he pins'
ya+ħarb+u 'they run away'	ya+ħrab 'he runs away'

7. Metathesis as the product of elementary operations

Although the quality of the metathesized vowel cannot be attributed to default assignment, I claim that epenthesis is nonetheless instrumental in accounting for the plural stem vowel in the verbs above. Epenthesis in conjunction with the two independently motivated processes of syncope and vocalic mapping result in metathesis. Thus unlike earlier analyses, I claim that metathesis is the product of

three elementary operations which in nonlinear terms we can identify as delink, insert and associate.

It will be recalled that all verbs which evidence metathesis have a medial sonorant consonant, i.e. [m, n, l, r]. As mentioned briefly above, an important observation regarding these consonants is that a vowel always precedes them when they occur word-internally between two consonants or word-initially as the first member of a consonant cluster. For all other consonants, a vowel is not required. Examples of this were given in (16). Due to sonority considerations a sonorant consonant is unable to syllabify with a following onset or preceding coda consonant (Hume 1990c).

(18) Epenthesis:

$\emptyset \rightarrow V / \_\_ C'$

An empty vowel slot is inserted before an unsyllabifiable consonant.

Vowel epenthesis as stated in (18) thus serves to provide a nucleus for the unsyllabifiable consonant. An empty vowel slot is inserted and in the absence of assimilation processes and vocalic mapping, this empty vowel slot surfaces as [i] by default. Since epenthesis applies both word-internally and across word-boundaries, I assume that it is a post-lexical rule.

In my account of metathesis in the plural imperfective, syncope applies to all plural verbs without exception. This illustrated in (19) for the verb [yokorbu] 'they groan'. Due to syncope, both the first and second vowels of the plural stem delete. For verbs with a medial sonorant consonant, this leaves the medial consonant in an unsyllabifiable position and as a result, epenthesis is required. Note that it is only because syncope has applied that epenthesis is required. Recall that syncope only deletes the vocalic slot while leaving the melody floating. Since epenthesis now provides an empty vowel slot, the floating melody maps onto this slot by universal association conventions (vocalic mapping).

(19)

Lexical: input	C V C V C
(after plane conflation)	| | | | |
	k o r o b
1st cycle:	
Syncope	n/a
2nd cycle: input	yV korob
Syncope	yV k rob
	[o]'
Vocalic Mapping	yV k rob
	[o]'
3rd cycle: input:	yó krob u
Syncope	y o kr b u
	[o]'
Post-lexical	
Epenthesis	y o kV́ r b u[2]
	[o]'
Vocalic Mapping	y o kV r b u
	[o]'
Output:	[yokórbu]
	'they groan'

To summarize, the three elementary operations which result in metathesis are: syncope, epenthesis and vocalic mapping. The first two operations are independently motivated rules of Maltese, and the third, vocalic mapping, is a universal convention.

8. The Interaction of Guttural Assimilation and Metathesis

Due to the interaction of guttural assimilation and metathesis, vowel movement across an intervening consonant cannot take place before plane conflation. Recall from the discussion above, that when GA occurs, the melodies of consonants and vowels must be on the same plane. In the derivation in (20), I illustrate the interaction of GA and the operations that result in metathesis. On the left, I give the derivation of the verb [yaħilbu] 'they milk'. To the right, I include the derivation of the singular perfective form of this verb for comparison.

(20) Metathesis and Guttural Assimilation

Lexical: input /ħilib/	C V C V C	C V C V C
(after plane conflation)	| | | | |	| | | | |
	ħ i l i b	ħ i l i b
1st cycle:		
Syncope	n/a	n/a
2nd cycle: input	yV ħilib	ħílib
Syncope	yVħ lib	n/a
	[i]'	
Vocalic Mapping	yVħ lib	n/a
	[i]'	
3rd cycle: input	yi ħlib u	
Syncope	yi ħl bu	n/a
	[i]'	
Vocalic Mapping	n/a	n/a
Non-cyclic		
Guttural Assimilation	yáħl bu	ħalib
	[i]'	
Post-lexical		
Epenthesis	yaħVl bu	n/a
	[i]'	
Vocalic Mapping	yaħVl bu	n/a
	[i]'	
i-lowering	n/a	ħaleb
Output:	[yaħilbu]	[ħáleb]
	'they milk'	'he milked'

As shown in (20), no rules apply until the second cycle. At this point, syncope applies in the imperfective and deletes the vowel slot of the initial vowel while leaving the melody floating. By vocalic mapping, this melody maps onto the prefix vowel. In the third cycle, we see the second application of syncope yet since there is no empty vowel slot the vocalic melody of the syncopated vowel remains afloat. Guttural assimilation then applies in a noncyclic fashion affecting only the prefix vowel in the plural form and the initial stem vowel in the perfective. Finally, epenthesis applies post-lexically and the floating melody links up to the V-slot[3].

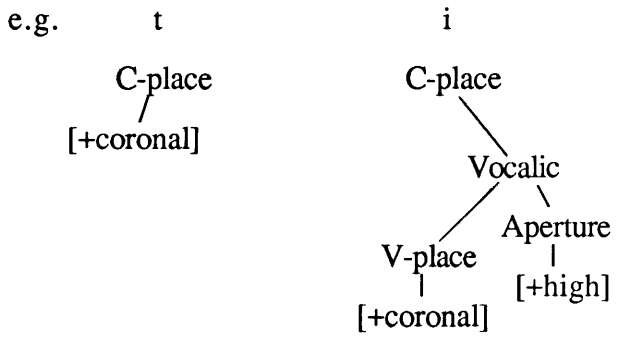
Note that epenthesis and vocalic mapping apply crucially after guttural assimilation. If the order were reversed, the first stem vowel of the plural would be a target for GA and the prefix vowel as well as the stem vowel would incorrectly surface as [a], as shown in (15). Note also that is not necessary to stipulate this ordering since the rules are themselves intrinsically ordered by their stratal assignments.

At the point which guttural assimilation applies the melodies of consonants and vowels must be on the same plane. Moreover, as we have seen, vocalic mapping must take place after guttural assimilation. Consequently, complete vowel movement across the intervening consonant cannot imply planar V/C segregation. This is a significant point since Maltese Arabic would seem to be the type of language in which we would expect planar segregation to be invoked. Yet as shown, this account isn't available. Thus if metathesis cannot be attributed to planar segregation in Maltese, a language in which we might expect it to occur, it is reasonable to ask whether there isn't an alternative means of representing vowel movement across a consonant, both for Maltese and potentially for other languages as well.

9. The Nonlinear Organization of Consonant and Vowel Features

Within the well-motivated view of assimilation as spreading, an adequate model of feature organization must allow non-local spreading to propogate across intervening segments without crossing association lines. In the case of entire vowel movement across an intervening consonant, the features of consonants and vowels must then be maintained sufficiently separate. At this point we need to ask what features of consonants and vowels are relevant? In the unmarked case, it is clear that all features except those characterizing a vowel's place of articulation and height are predictable. As a result, spreading at most a vowel's feature specifications for place and height is sufficient to result in total vowel movement. I would argue then that the only features of consonants and vowels that need to be maintained separate are the place and height features of vowels and consonants.

(21) Feature Organization (based on Clements, in press):



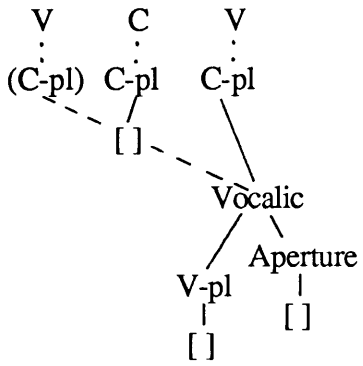
The model of feature organization proposed in Clements (in press) allows for an alternative means of representing vowel movement without invoking complete planar segregation. In this model, consonants and vowels are specified for the same set of articulator features yet, as shown in (21), the place features of consonants and vowels occur on independent tiers (only relevant structure is included). To be more specific, vowel place features are linked to a V-place node which is in turn dominated by a Vocalic node. Vocalic also dominates the height (or aperture) features of vowels. Vocalic is ultimately dominated by a C-place node as are consonantal place features. In the unmarked case, I assume that vowels are

specified only for place features dominated by Vocalic, and consonants only for place features immediately dominated by C-place.

This model makes a number of strong predictions. One is that consonants and vowels which are specified with a common place feature should pattern together as a natural class. Independent evidence for this comes from, for example, vowel-to-consonant assimilation in Maltese as discussed in Hume (in press); the guttural consonants [ħ,ʔ] and [a] pattern together as the natural class [+pharyngeal], and front vowels and coronals consonants, both anterior and non-anterior, pattern together as the natural class [+coronal] (for numerous other examples see Clements, in press; Herzallah 1990).

This model also predicts that in the unmarked case, vowel movement should occur across an intervening consonant without crossing association lines[4]. This is illustrated in (22). The vocalic node of the vowel, dominating its place and height features, spreads across an intervening consonant without crossing association lines. In this and subsequent representations, only relevant structure is given and interpolated nodes on the target are enclosed in parentheses.

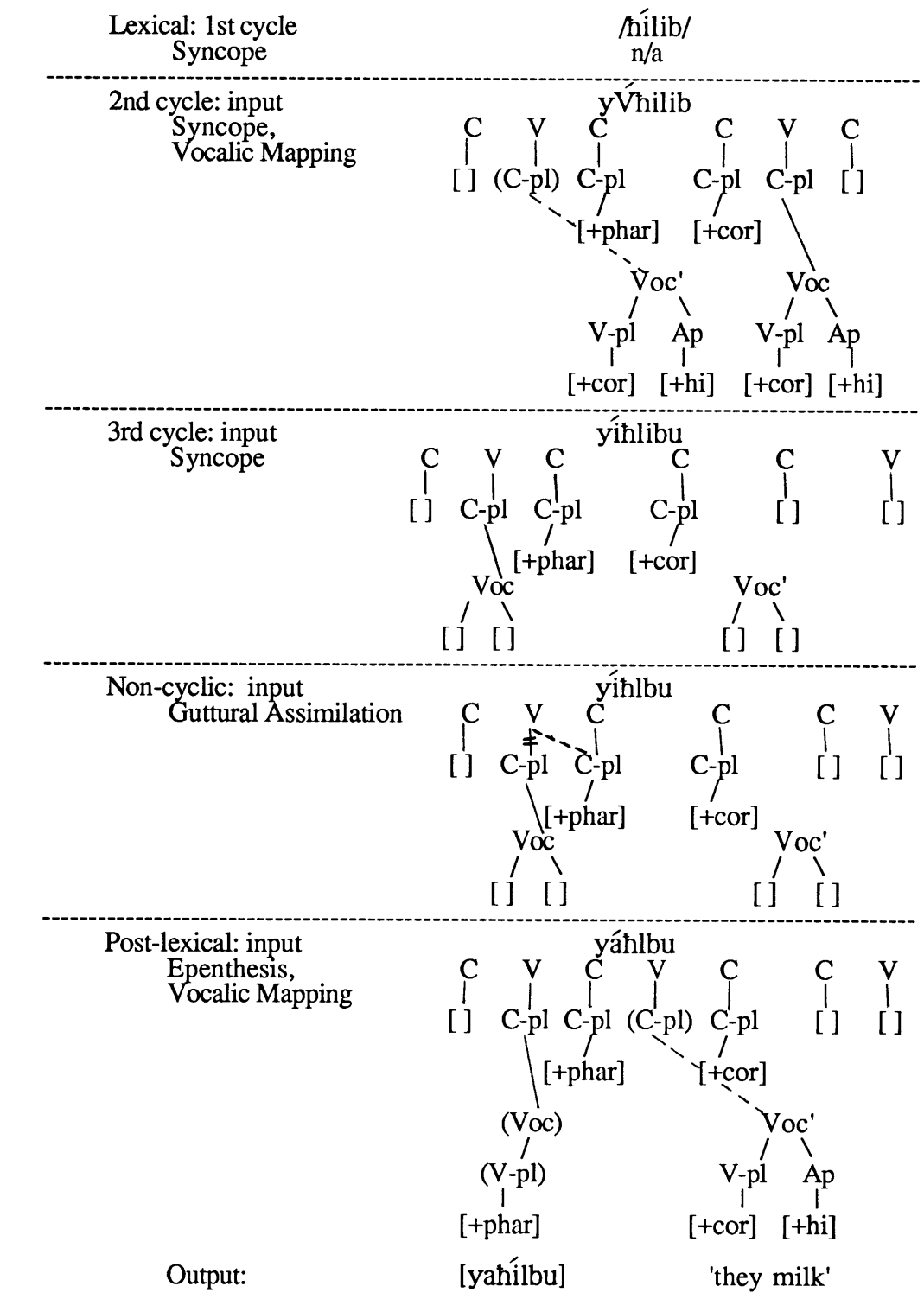
(22) Vowel Movement



By incorporating this model into the representation of metathesis in Maltese, vowel movement applies across an intervening consonant without invoking planar V/C segregation. This is illustrated in the revised derivation of 'to milk' in (23).

As in (20), no rules are applicable until the second cycle, at which point syncope applies deleting the V-slot of the stem-initial vowel. By vocalic mapping, the floating melody links up to the V-slot of the prefix. In the third cycle, syncope applies once more deleting the vowel slot of the remaining stem vowel. Guttural assimilation then changes the prefix vowel to [a] by spreading the C-place node onto the next superior node of the vowel. The original specification of the vowel is delinked and relevant nodes are interpolated. Finally, epenthesis applies and the floating melody spreads across the intervening consonant and links up to the V-slot. Vowel movement thus occurs across an intervening consonant without planar segregation and without crossing association lines.

(23) Metathesis in the plural imperfective:



10. Conclusion

Consonant/vowel metathesis has been thought to constitute partial evidence for falsifying the Strong Morphemic Plane Hypothesis (McCarthy 1989b). In languages in which consonants and vowels do not constitute separate morphemes, planar V/C segregation has been supposed to be necessary to account for vowel movement across an intervening consonant. Moreover, it has been suggested that metathesis implies planar segregation. In this paper, I have provided independent evidence from consonant/vowel metathesis in Maltese that not all cases of vowel movement imply planar V/C segregation. By drawing on an enriched model of feature geometry, an alternative account has been given. I would suggest then that there is perhaps an alternative means of accounting for metathesis in other languages, cases which would otherwise constitute exceptions to the Strong Morphemic Plane Hypothesis.

Notes:

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1 The prefix vowel is systematically realized as [i] when followed by a stem-initial coronal obstruent (see Hume, in press).

2 The stem vowel in plural forms evidencing metathesis bears stress. I assume stress shifts rightward with the insertion of the epenthetic vowel.

3 Further evidence for this ordering comes from verbs such as [yiflaħ]/[yifilħu] 'he is strong/they are strong' < /yV+filiħ/, /yV+filiħ+u/. In verbs of this type, it is crucial that guttural assimilation applies after the second stem vowel has deleted. Otherwise, the metathesized vowel would surface incorrectly as [a].

4 Vowel movement across a consonant with a secondary (vocalic) articulation is predicted to be blocked.

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